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Deep Lyα imaging of radio galaxy 1138−262 at redshift 2.2

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Abstract. Observations of the powerful radio galaxy 1138−262 at $z = 2.2$ suggest that this galaxy is a massive galaxy in the center of a forming cluster. We have imaged the field of 1138−262 with the Very Large Telescope[1] in a narrow band encompassing the redshifted Lyα emission. We detect 34 probable line emitters in the $6' \times 6'$ field. These are candidate Lyα emitting galaxies in the supposed cluster. The observations also reveal that the radio galaxy is enclosed by a very extended Lyα halo ($\sim$ 160 kpc).

1. Introduction

Observations of clusters at high redshift ($z > 2$) can directly constrain cosmological models, but searches based on colors or narrow band emission have not discovered more than a handful of presumed cluster galaxies (Le Fèvre et al. 1996; Cowie & Hu 1998). There are several indications that powerful radio galaxies at high redshift (HzRGs) are located at the centers of forming clusters. The powerful radio galaxy 1138−262 has extensively been studied and there is strong evidence that it is a forming brightest cluster galaxy in a (proto-)cluster (e.g. Pentericci et al. 1997). The arguments include (i) the very clumpy morphology of 1138−262 as observed by the HST (Pentericci et al. 1998), reminiscent of a merging system; (ii) the extremely distorted radio morphology and the detection of the largest radio rotation measures ($\sim$ 6200 rad m^{-2}) in a sample of more than 70 HzRGs, indicating that 1138−262 is surrounded by a hot and dense magnetized medium (Carilli et al. 1997); (iii) the detection of extended X-ray emission around 1138−262 (Carilli et al. 1998), indicating the presence of hot cluster gas.

2. A cluster at redshift 2.2?

With the aim of detecting Lyα emitting cluster galaxies, the field of 1138−262 was observed on April 12 and 13 1999 with FORS1 on the VLT ANTU using a narrow band (65 Å) covering the redshifted Lyα (3814 Å), and the broad B band which encompasses the narrow band. The resulting Lyα image shows a

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[1]Based on observations collected as part of programme 63.O-0477 at the European Southern Observatory, Paranal, Chile.
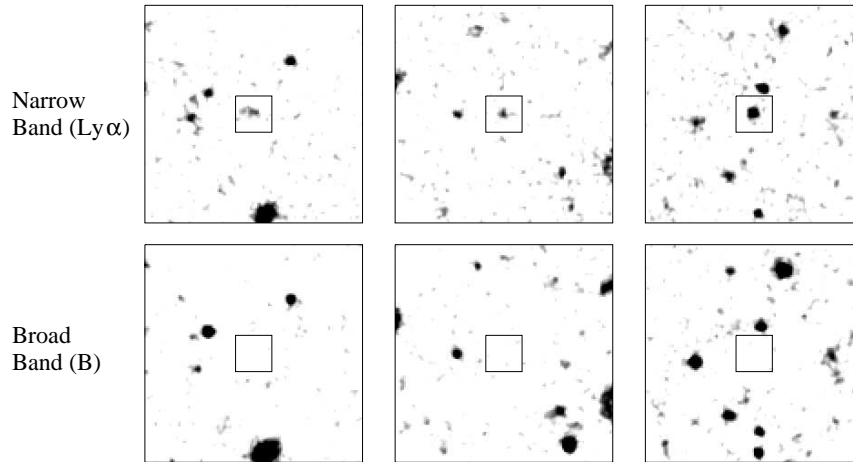
Figure 1.   Three probable cluster companions in NB(Lyα) and BB(B)

huge (~ 160 kpc)^2 halo of ionized hydrogen around the galaxy, which extends even further than the radio emission.

From a combined Lyα and B band image we have extracted ~ 1600 sources with SExtractor (Bertin & Arnouts, 1996), after a careful consideration of the aperture size to be used for the photometry. Objects, that are detected in the narrow band image at a level 3σ higher than expected from the broad band image, are selected as candidate Lyα emitters. Discarding 6 bright stars, we detect 34 such objects in the 3×3 Mpc^2 field with a range of Lyα fluxes from 0.1-5×10^{-16} ergs s^{-1} cm^{-2}. These are obvious candidates for being companion galaxies in the cluster around $1138-262$. Three of these candidates are shown in Fig. 1. The next step will be to measure the redshifts of the Lyα emitters and subsequently determine the spatial correlation function and the velocity dispersion, which together with the size of the cluster will give a direct estimate of the total mass.

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^{2}We adopt a Hubble constant of H_0=50 km s^{-1}Mpc^{-1} and a deceleration parameter of q_0=0.5.